

# TSC Findings on the Space Weather Operations, Research and Mitigation (SWORM) Task Force Report

Results from the LWS TR&T Steering Committee meeting  
on Feb 8-9 2016

# National Space Weather Strategy

*A cohesive all-of-government strategy was necessary to ensure the federal government was positioned to mitigate, respond to and recover from a major space weather storm*

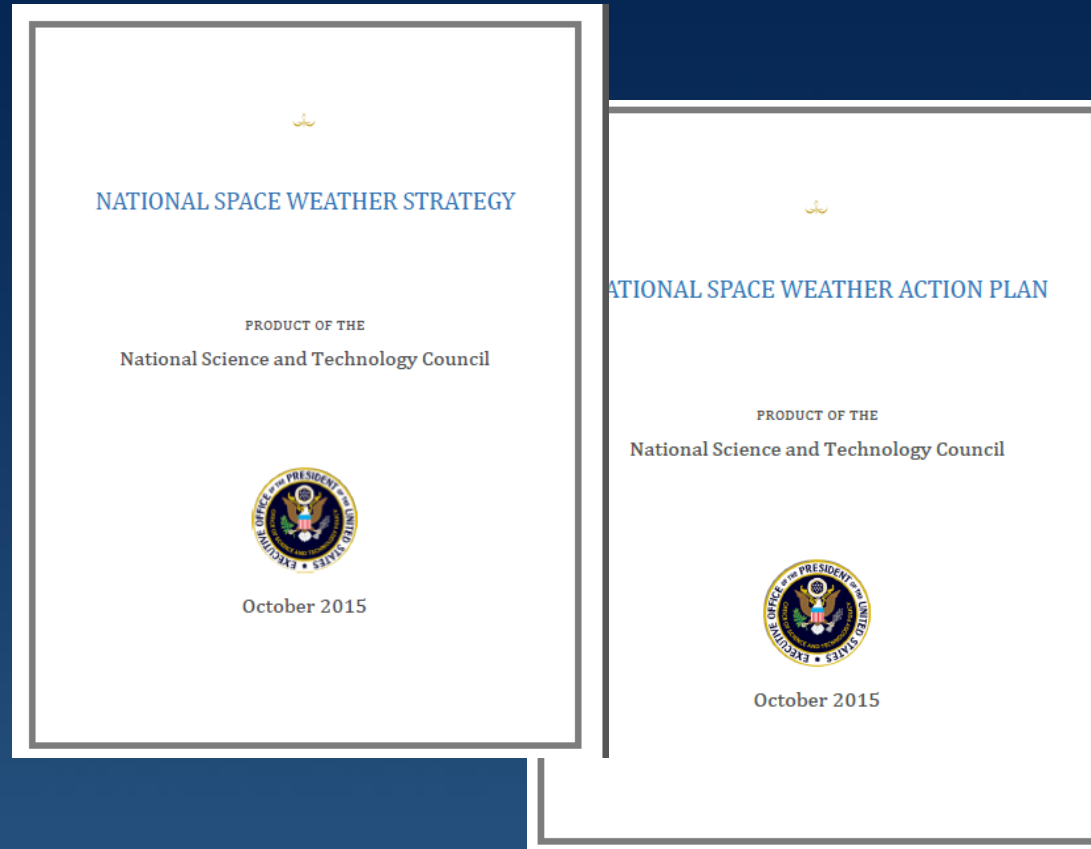
Nov 2014 – Space Weather Operations, Research, and Mitigation (SWORM) Task Force is established

Tasked to develop:

- National Space Weather Strategy (NSWS)
- Space Weather Action Plan



# *The National Strategy and Action Plan*



Released on 29 October 2015



# Steering Committee Charge

- Long-term alignment: development of traceability matrix between TR&T SSAs and SWORM goals
- Short-term tasks: development of findings on possible TR&T mechanisms to provide science to inform benchmarking efforts.

# Structure of the Action Plan (6 goals)

With the objectives of improving understanding of, forecasting of, and preparedness for space-weather events (both the phenomena and their effects), the *National Space Weather Strategy* defines six strategic goals to prepare the Nation for near- and long-term space-weather effects. This Action Plan is organized around the same six strategic goals:

1. Establish Benchmarks for Space-Weather Events
2. Enhance Response and Recovery Capabilities
3. Improve Protection and Mitigation Efforts
4. Improve Assessment, Modeling, and Prediction of Impacts on Critical Infrastructure
5. Improve Space-Weather Services through Advancing Understanding and Forecasting
6. Increase International Cooperation

# Goal 1: Establish Benchmarks for Space-Weather Events (5 topic areas)

1. Induced geo-electric fields
2. Ionizing radiation
3. Ionospheric disturbances
4. Solar radio bursts
5. Upper atmospheric expansion

## **Timeline:**

Phase 1 benchmarks: 180 days [\(June-July 2016\)](#)

Complete Assessment report of gaps: 1 yr [\(Jan 2017\)](#)

Phase 2 updated benchmarks: 2 yr [\(Jan 2018\)](#)

# **TSC Findings on the Space Weather Operations, Research and Mitigation (SWORM) Task Force Report**

- The LWS TR&T Steering Committee (TSC) recognizes that NASA's responses to the National Space Weather Action Plan (SWAP) tasks will require immediate and dedicated actions by the LWS program in addition to activities already underway. The following represent the TSC findings on a process by which the LWS TRT Program Office can respond to and carry out LWS-related SWAP activities.

## **Finding 1:**

The TSC suggests the following short-term task to assist NASA in carrying out its SWORM benchmarking activities:

- NASA should establish LWS SWORM “Tiger Teams” to support the five SWORM benchmarking activities. These teams would be distinct from, but complementary to current LWS teams, such as the Focused Science Topic teams and the Strategic Capability teams.
- The charter of each Tiger Team would be to
  - Assist and support the government study board by providing findings as directed and by reviewing the gap assessment performed by the governmental study board. Specifically, the teams would identify gaps in science, perform evaluation of uncertainties, and identify collections of available data, as well as critical missing data.
  - Identify and implement any short-term science actions that need to be taken to feed into the Phase-2 improved benchmarking process. Science actions could include synthesizing models and data, and providing tools relevant to benchmarking.
- A fast-track selection process should be implemented so that the Tiger Teams have sufficient time to complete their tasks within the deadlines identified in the SWAP. Based on these deadlines, the announcement-to-selection process should be no more than a few months.
- For this fast-track process, no restrictions should be put on proposal teaming structures in order to maintain flexibility to best serve the SWORM activities. For example, both team proposals and individual proposals should be allowed for each benchmarking topic, thus allowing the LWS Program Office the flexibility to form the tiger teams from these proposals and / or to select individual investigations.



## **Finding 2:**

- With regards to the longer-term activities identified in the SWAP report, the TSC finds that it should trace out the correspondence between all the SWORM actions to which NASA is contributing and the LWS TR&T Strategic Science Areas (SSA's).
- Based on this correspondence, the TSC should develop findings at its next meeting detailing how the TR&T's SSA-targeted activities can feed into and / or address NASA SWORM actions.
- In future years, the TSC should include Tiger Team feedback to the program in order to more closely align TR&T activities to the SWORM goals.

EXTRA SLIDES

# Ionizing radiation benchmarking

- At a minimum, the ionizing radiation benchmarks and associated confidence levels will define at least the radiation intensity as a function of time, particle type, and energy for the following event-occurrence rate and intensity level:
- An occurrence frequency of 1 in 100 years; and
- An intensity level at the theoretical maximum for the event.  
The benchmarks will address radiation levels at all applicable altitudes and latitudes in the near-Earth
- environment, and all benchmarks will state the assumptions made and the associated uncertainties. The following actions will be taken to develop ionizing radiation benchmarks:
  - 1.2.1 NASA and DOC, in coordination with NSF, the Department of Transportation (DOT), the Department of Defense (DOD), and the Federal Communications Commission (FCC), will: (1) assess the feasibility and utility of establishing functional benchmarks for ionizing radiation using the existing models and body of literature for this phenomenon; and (2) use the existing body of work to produce benchmarks.
  - Deliverable: Develop Phase 1 benchmarks
  - Timeline: Within 180 days of the publication of this Action Plan
  - 1.2.2 NASA and DOC, in coordination with NSF, DOT, DOD, and FCC, will assess the suitability of current data sets and methods to develop a more-refined (compared to Phase 1) set of benchmarks. The assessment will identify gaps in methods and available data, project the cost of filling the gaps, and project the improvement to the benchmarks based on filling each gap.
  - Deliverable: Complete assessment report
  - Timeline: Within 1 year of the publication of this Action Plan

## 5.4 Improve Forecasting Lead-Time and Accuracy

- Space-weather forecasters analyze near-real-time ground- and space-based observations to assess the current-state space environment. Forecasts are based on a mixture of observations and model calculations, with models relying on observations as inputs. Actions identified to improve both the accuracy and lead-time of space-weather forecasts include:
- 5.4.1 NASA and DOC will assess space-weather-observation platforms with deep-space orbital positions (including candidate propulsion technology), which allow for additional warning time of incoming space-weather events.
- Deliverable: Complete assessment report
- Timeline: Within 1 year of the publication of this Action Plan
- 5.4.2 NASA, DOC, DOD, and NSF will support the development of novel sensor technologies and instrumentation to improve forecasting lead-time and accuracy.
- Deliverable: Complete assessment of technology needs Timeline: Within 1 year of the publication of this Action Plan
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- 5.4.3 NASA, DOC, DOD, and NSF will prioritize and identify needs for improved coverage, timeliness, data rate, and data quality for space-weather observations, and opportunities to address these needs through collaborations with academia, the private sector, and international community.
- Deliverable: Develop a report with priorities and recommendations
- Timeline: Within 1 year of the publication of this Action Plan and every year thereafter, as necessary

## 5.5 Enhance Fundamental Understanding of Space Weather and Its Drivers to Develop and Continually Improve Predictive Models

- Accurate space-weather forecasts depend largely on understanding the complex interactions between the sun and the Earth. Limited understanding of these interactions hinders accurate forecasting of space-weather events. Additional effort is needed to improve the understanding of these sun-Earth interactions that produce space weather. Actions identified to advance these efforts include:
- 5.5.1 NSF and NASA, in collaboration with DOC and DOD, will lead an annual effort to prioritize and identify opportunities for research and development (R&D) to enhance the understanding of space weather and its sources. These activities will be coordinated with existing National-level and scientific studies. This effort will include modeling, developing, and testing models of the coupled sun-Earth system and quantifying the long- and short- term variability of space weather.
- Deliverable: Document R&D priorities
- Timeline: Within 1 year of the release of this Action Plan and every year thereafter, as necessary
- 5.5.2 NASA, NSF, and DOD will identify and support basic research opportunities that seek to advance understanding of solar processes and how the sun's activity connects to and drives changes on Earth and its near-space environment.
- Deliverable: Announce and provide financial awards that enhance basic research in this area
- Timeline: Within 1 year and sustained thereafter
- 5.5.3 NASA, DOC, and DOD will identify and support research opportunities that seek to address targeted operational space-weather needs.
- Deliverable: Announce and provide awards that enhance research in focused areas
- Timeline: Within 1 year and sustained thereafter